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TOWARD A LESS HARMFUL CIGARETTE

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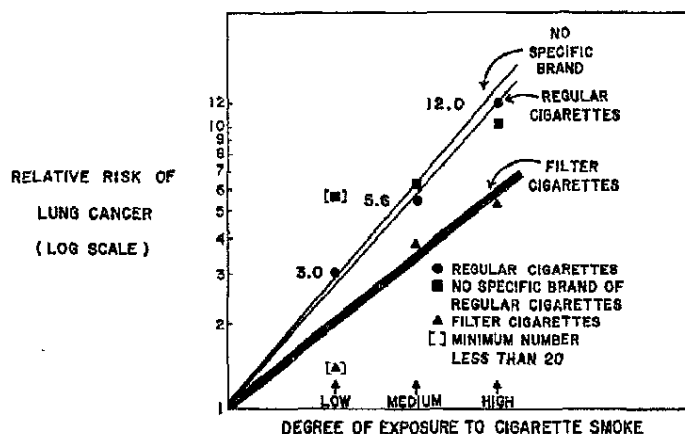
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Effect of Filter Cigarettes on the Risk of Lung Cancer

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SOME epidemiological data are presented on the question: Does switching to filter cigarettes reduce the risk of lung cancer? On the basis of these data, the answer is: The risk seems to be reduced to about 60% of what it would have been if the smoker had not switched. Unfortunately, however, even with this reduction the risk is still 4 times that of a nonsmoker, and further steps toward a less harmful cigarette are needed.

The data here are on 974 white male patients with lung cancer who were seen at Roswell Park Memorial Institute between 1960 and 1966. These patients have been matched case-for-case on age and entry date with white male patients who had no diagnosis of neoplastic disease and who were seen at the same institution in the same time period. Table 1 gives the basic data. It also defines the degree of exposure categories used in text-figure 1. However the discussion will focus on text-figure 1 since this one



TEXT-FIGURE 1.—Relative risk of lung cancer by type of cigarette and degree of exposure: Risks relative to those of nonsmokers. Lines show filter risks are 60% of the regular risks.

TABLE 1.—Risks of lung cancer (relative to nonsmokers) for persons currently smoking regular and filter cigarettes by total years smoked cigarettes and daily amount smoked

Exposure			Regular cigarettes			Filter cigarettes		
Years smoked	Daily quantity	Degree	Number		Relative risk	Number		Relative risk
			Case	Control		Case	Control	
Under 30	1 pack or less	Low	15	20	3.41	3	11	1.23
	More than 1 pack	Low	6	12	2.27	2	5	1.82
30-39	1 pack or less	Medium	30	21	6.50	11	16	3.14
	More than 1 pack	High	28	10	12.73	9	11	3.73
40-49	1 pack or less	Medium	46	43	4.86	15	15	4.54
	More than 1 pack	High	24	9	12.14	12	9	6.04
50 and over	Under 1/4 pack	Medium	13	8	7.27	2	2	4.54
	1/4-1 pack	High	26	13	9.09	9	6	6.82
	More than 1 pack	High	12	2	27.27	2	1	9.09
Total			200	138	6.59	65	76	3.90

graph tells a great deal about the human health hazards of our present cigarettes:

1) Persons who smoked specific brands of regular cigarettes for less than 30 years have been put in the category of "regular cigarettes: low degree of exposure to cigarette smoke." Their relative risk is 3—which means that their risk of lung cancer is 3 times greater than that of a nonsmoker.

2) Persons who have smoked specific brands of regular cigarettes for 30–50 years but who smoke a pack a day or less have (with one minor exception) been put in the category of "regular cigarettes: medium degree of exposure to cigarette smoke." Their relative risk is 5.6—almost double the risk in the low-exposure group. Persons who smoke more than a pack a day and have smoked for more than 30 years can be said to have a "high degree of exposure to cigarette smoke." They have roughly double the risk of the persons with "medium exposure." These smokers with "high exposure" have a 12 times greater risk of lung cancer than nonsmokers.

3) For various reasons some people did not give details on specific brands. They are shown in the text-figure under the heading "no specific brand." Except for the "low-exposure" risk, the relative risks in these patients are similar to those in the "regular cigarettes" series. The series might have been combined with the "regular cigarettes" series but has been kept separate here to show the reproducibility of the risk estimates in the most direct fashion. The reproducibility is quite good until the minimum number of patients in a category becomes less than 20.

4) Let us now consider the persons who switched to filter cigarettes. Text-figure 1 shows clearly that the risks for these smokers are lower than those for regular cigarette smokers who, on the basis of amount and duration of smoking, would have had a similar degree of exposure to cigarette smoke. In the high-exposure series, the relative risk is reduced from 12.0 to 5.4. In the medium-exposure series, the risk goes from 5.6 to 3.9. Even in the low-exposure series, there appears to be a reduction from 3.0 to 1.4, although these estimates are less reliable due to the smaller numbers.

5) The straight lines drawn on the text-figure are based on the overall risks for each type of cigarette. Most of the points lie fairly close to these lines. This indicates that the reduction in risk is similar for all degrees of exposure. Therefore, to obtain an overall estimate of the reduction in risk from a switch to filter cigarettes, we use the ratio of the slopes of the lines. This leads to the estimate that the person who switches to a filter cigarette has about 60% of the risk of a person in the same exposure category who continues to smoke regular cigarettes.

6) The reduction in risk for the filter smokers is of considerable scientific and practical importance. Therefore we would want some assurance that these results are not due to sampling variation alone. We can obtain this assurance in two ways. The first procedure is to set confidence intervals on the estimate of 60%. The confidence interval is fairly wide—from 38–91%—but it indicates that there has been some reduction in risk in the

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filter series. A second procedure (which avoids the assumption that the same reduction occurs in all degrees of exposure) is called "Cochran's test." This test tells us that there is less than one chance in a hundred that this result could be due to sampling variation ($P=0.004$).

7) Text-figure 1 shows one further point that should not be overlooked. The filters seem to provide some protection, *but this protection is still inadequate*. Even with a switch to filters, a person with a high degree of exposure to cigarette smoke has over 5 times the risk of lung cancer for a nonsmoker. Filtration is a step in the right direction, but further steps are needed. Existing filter technology enables us to take such steps immediately.

8) There is another, more subtle, point of importance to public health action that this text-figure makes. With about 1,000 lung cancer patients it was possible to see clearly differentials in risk for the filter cigarettes. It took us 6 years to amass this series. But there are over 50,000 lung cancer deaths each year. If a nationwide, retrospective surveillance system were set up which was patterned after this study, it could easily get 5,000 cases in a single year. Such a system could monitor any steps toward safer cigarettes that might be taken. Definite answers to questions about reduction in human hazards should be obtainable in 3-5 years.

The above findings show that current filter cigarettes are *not* the answer to the problem of lung cancer, and to this extent they are discouraging. On the whole, however, they encourage the search for a less harmful cigarette. These findings provide the first human evidence that redesign of the product can reduce health hazards. They indicate that, if full advantage were taken of existing filter and other cigarette technology, a greater protection could be provided immediately. In the competitive situation in the cigarette market, however, government standards for filter cigarettes are probably a prerequisite to progress in this direction. Finally, the findings suggest the feasibility of monitoring progress toward a less harmful cigarette. A surveillance system would permit a direct test of the various speculative theories of carcinogenesis and of the different animal model systems and would speed development of less harmful cigarettes in other ways. The present findings should be viewed with some caution since they still require confirmation by other investigators, but they represent an encouraging result in an area where such results are infrequent.

APPENDIX

Due to the unexpected findings of this study, Dr. Bross answered specific questions about the validity and interpretation of his data.

* * *

Question: Isn't it true that some filters are not effective? Why didn't you separate the effective and noneffective filters?

Answer: Recent studies have shown a wide range of effectiveness for filters. We have looked into the individual filter brands. The problem is that this cross-tabulation

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fractionates the data and the series become small and unreliable. We have found some suggestive differences. However, we felt that it might be misleading or unfair to try to separate the filter cigarettes on the basis of such fragmentary data. Furthermore, the brands which showed up poorly were not very common in this data and, therefore, including them with the other filters had little effect on the overall results.

Question: But doesn't it invalidate your results to lump together the effective and noneffective filters?

Answer: Not at all. Our focus here is on the differential between persons who smoke regular cigarettes and those who switch to filters. We have adopted a conservative analysis policy. Combining effective and noneffective filters would tend to reduce—not increase—any differential. This "bending over backwards" may lead us to understate the effect of filters, but in this first report an understatement seems preferable to an overstatement.

Question: Isn't it also true that a considerable portion of the patients in this study had smoked filter cigarettes for a relatively short time?

Answer: Yes, the arithmetic of the smoking habits insures this. The average age in this series is just over 60. Most people began smoking before they were 20. Since the interviews were in the 1960's, the patients began smoking around the 1920's. Filter cigarettes didn't become popular until the 1950's. By simple arithmetic, these people had smoked regular cigarettes much longer than they had smoked filter cigarettes.

Question: Why didn't you take the duration of filter cigarette smoking into account?

Answer: We were originally going to require that an individual who was smoking a filter cigarette at time of interview would only be classified as a smoker of this brand if he had smoked it for 3 years. Analysis on this basis gave results similar to those reported, but it markedly reduced the series size. It was also open to the objection that we were picking and choosing favorable groups among the persons who smoked filter cigarettes. Once again we adopted the conservative analytic policy of not subdividing the filter series in this presentation.

Question: Again, on the grounds that you prefer an understatement of the effect of filters to an overstatement—is that right?

Answer: Yes.

Question: Well I still find it hard to believe that filters could have even this much effect. You've just acknowledged that filter cigarettes were smoked for a relatively short time. What's more even the better filters are far from fully effective in reducing tar. Therefore I don't see how switching to filters could give much of a reduction in the lifetime exposure to cigarette tar. Do you agree?

Answer: Yes. The reduction in lifetime exposure is rather minor—less than 10% in most cases. The reductions in risks we are finding here are not proportional to the reduction in lifetime exposure.

Question: Since the reduction in lifetime exposure is so minor, why did you expect to find a reduced risk in filter cigarettes?

Answer: We didn't expect to find this reduction.

Question: Do you mean that you undertook this study although you didn't expect to find these results?

Answer: That's right. The data was pre-processed, we had a new automated data-utilization system, and it was relatively easy to take a look at the facts. Our analytic policy is to report the facts as we find them, irrespective of whether these facts fit in with preconceived notions or personal preferences.

Question: Weren't you suspicious? Weren't you afraid that your results might be due to an artifact of your retrospective analysis?

Answer: Yes, we were aware of this danger. We rather expected that, when we took into account the amount and duration of exposure to cigarette tars, the effects might disappear. When we ran off tabulations such as those in table 1, we found the dif-

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ferential in risks for filters showing up consistently in the cross-categories. The effect didn't disappear.

Question: But couldn't it be somehow related to age?

Answer: We looked into this possibility. Although the lung cancer patients were originally age-matched, it was possible that partitioning by degree of exposure as in text-figure 1 had unbalanced the age distributions. We looked at the data and found this had not happened.

Question: What about the effect of switching, in and of itself?

Answer: We have looked at other switches—to regular menthol cigarettes, for example. The menthol series did not show a reduced risk of lung cancer.

Question: But you can't be absolutely sure that there isn't some artifact here, can you?

Answer: Of course not. In any actual scientific study—and particularly one that gets into a new area—there is always a risk of artifacts. Artifacts are tricky and there is a limit as to how much protection can be provided by internal checks. The best guard against artifacts is confirmation by independent investigators. Perhaps this cross-check will be available in the future.

Question: But doesn't there have to be an artifact here? Your data seem to show a reduction in the risk of lung cancer when filters are used which equals, if not exceeds, that of giving up smoking altogether. Isn't this illogical unless some artifact is operating?

Answer: The situation is puzzling and there does seem to be a strong artifact operating here. But it is the well-known selection effect in the ex-smokers: People who quit smoking tend to do so for health reasons. So it is not surprising to find that in the heavy-smoking lung cancer series there is quite a high proportion of ex-smokers. If there had been a similar selection effect in the filter switchers, we would not have found a reduction in risk. Apparently health problems are not an important factor in switching to filters. This in turn suggests that the key comparison—patients who continue to smoke regular cigarettes versus those who switch to filters—is valid.

Question: To sum up, where do you think we stand with respect to reducing risks of lung cancer by switching to less hazardous cigarettes?

Answer: We now have a substantial body of human data which suggest that it is possible to make progress toward control of lung cancer by the development and marketing of less hazardous cigarettes. This is one bright spot in an otherwise very gloomy picture. We should neither accept nor reject these findings merely because they are unexpectedly encouraging. Indeed, whether these findings should be wholeheartedly accepted or not is not really the crucial question.

Question: What is the crucial question then?

Answer: This study was originally undertaken as a pilot study to examine the feasibility of a retrospective surveillance system to guide the development of a safer cigarette. As a pilot study, it has been unusually successful—very few pilot studies lead to substantive results of the kind obtained here. The crucial question, then, is: What is the next step that can be justified on the basis of this evidence?

Question: And what would you say is the next step?

Answer: At present it does not seem feasible to proceed directly to the setting up of a nationwide surveillance system. On the other hand, these results suggest that further steps should be taken to exploit these new possibilities. With comparatively modest support from public health agencies, it would be possible to have a few large cancer hospitals form a voluntary surveillance system. This group could participate in a study to see if the findings reported here can be confirmed. At the same time the group could work out methodology, e.g., standard interview procedures, for future studies. The evidence presented here is surely strong enough to justify taking this second step.

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